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HERMAPHRODITISM IN *SABELLA MICROPH- THALAMA* VERRILL.

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In *Sabella microphthalama* Verrill, a paired, hermaphroditic sex organ appears in each segment of the body posterior to the pharynx. The study of this hermaphroditic condition was suggested by Professor Treadwell, who collected the material at Woods Hole, Massachusetts, in 1902-1903. The specimens were preserved in Hermann's fluid and stained in iron hæmatoxylin.

In general, the arrangement of organs as seen in cross section

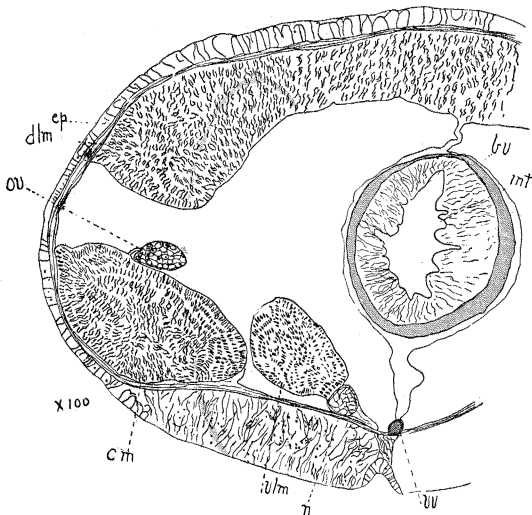


FIG. 1. Semi-diagrammatic cross section through the anterior portion of the body; *bv*, blood vessel; *cm*, circular muscles; *dlm*, dorsal longitudinal muscles; *ep*, epidermis; *int*, intestine; *n*, nerve cord; *ov*, ovary; *vlm*, ventral longitudinal muscle; *vv*, ventral blood vessel.

through the body is similar to that of other annelids. The paired sex organ is found on the dorsal side of the ventro-lateral bands of longitudinal muscles in the anterior end of each segment posterior to the setæ. It is supplied with blood from branches of the ventral blood vessel. Fig. 1 is a semi-diagrammatic draw-

ing of one half of a cross section through a segment toward the anterior end of the body, showing the position of the sex organ in its relation to its surroundings.

Animals killed during the months of April, May, June, July and August differed from one another with respect to the form and contents of the sex organ, as well as to the condition of the body cavity.

All specimens killed in April and the early part of May were found to be pure females. Fig. 1 is a cross section through the body of a specimen killed April 27, showing the organ, which is a pure ovary. Fig. 2 is a magnified drawing of the ovary in

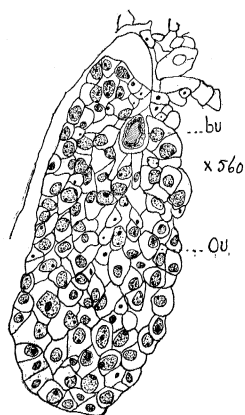


FIG. 2. Magnified drawing of ovary in Fig. 1. *bu*, blood vessel; *ou*, ova.

Fig. 1. This is a typical organ found during the early months. It is a long, somewhat pear-shaped body, one end extending into the body cavity, the other end being attached by a band of tissue to the lateral muscles. At this same end is found the blood vessel. The cells are irregularly arranged and are in different stages of development; the majority of them contain very large nuclei with one or more nucleoli. In this organ there seems to be no definite arrangement of cells, large and small being intermingled. In the early part of April the organ is much smaller but it has the same characteristics as

the one described. In none of these animals are the sex products found free in the body cavity.

The animals killed during the months of May, June and July, with one exception, were hermaphrodites. During these months large masses of spermatozoa, and ova varying from the small oögonium to the large ovarian egg, were found free in the body cavity. Fig. 3 is a section through the body cavity of a specimen killed July 13, showing the different stages in the development of the ova as well as the masses of spermatozoa, both found free from the organ. *A* and *B* are sections through the outer surface of two large ovarian eggs. In the next section they have an appearance similar to that of *C*, *D* and *E*.

During August both hermaphrodites and females were found, the former being the more common.

Of the entire number examined, one third were distinctly female, and all but three of this number appeared among the specimens killed during April. No pure males were found in the material at my disposal. From these observations, it appears that the sexes are distinct at the beginning and end of the season, while during the middle of the season the sexes are united.

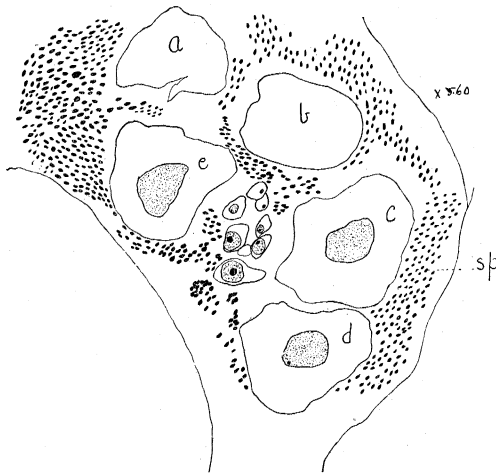


FIG. 3. Section through body cavity showing free ova and spermatozoa. *a, b, c, d*, ovarian eggs; *sp*, spermatozoa.

A typical hermaphroditic organ is seen in Fig. 4. It differs from the typical ovary in that it is shorter, broader, and more kidney shaped. Although ova and spermatazoa are found scattered throughout the organ, the majority of the ova appear massed together at the broader anterior end, while the larger number of male cells are found at the opposite end of the organ near the blood vessel. The ova are all in about the same stage of development. The cells on the very outer edge are ready to fall into the body cavity, where they undergo their further development. The male cells are in different stages of karyokinesis. In many cells the chromatin appears as a large, deeply stained mass, in some spindle shaped, in others in the form of an aster. In a few cells spermatozoa are found almost mature. Outside of the organ in

the body cavity are seen cells still undeveloped, cells almost mature with a thin membrane about them, and cells entirely free. Together with these are found the ova. As a general rule the spermatozoa seem to pass through the greater part of their development in the organ before passing into the body cavity, while the ova fall into the body cavity in an immature condition and undergo the greater part of their development free from the organ.

In a great many cases, spermatozoa could not be found in the organ but were found in great masses in every segment. Ova

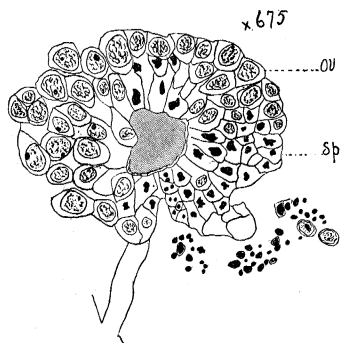


FIG. 4. Hermaphroditic organ.
Ov, ova; sp, spermatozoa.

filled the organ and were also free in the body. In other specimens spermatozoa were found in the posterior end of the body cavity only, while ova were found in the organ and free in the body cavity. From these observations it appears that the male products develop first in the organ, the development beginning at the anterior end of the body. In the cases where spermatozoa were found only in

the body cavity, they had already developed in the organ and had become freed. In the cases where they were found only at the posterior end of the body, those at the anterior end had become mature and had passed entirely out of the body.

A comparison of these results with those found in *Ophryotrocha puerilis*¹ by Eugen Korschelt, shows many similarities as well as differences. In both annelids ova and sperm are found together in the same segment. In *Ophryotrocha* the sexual products are produced in a gland which has no definite structure, and which is merely a large sac in the body cavity. In *Sabella* the sex organ is more definite in outline and form. In this organ the sexual products are formed and develop until they pass into the body cavity where their appearance is similar to the appearance of the sexual gland in *Ophryotrocha*. In *Ophryotrocha* the sexual glands are found in about ten segments of the body. In the

¹ Eugen Korschelt, "Ueber *Ophryotrocha puerilis* Clap. Metschn.," *Zeit. f. Wiss. Zool.*, 1893-94, Bd. 57, pp. 272.

anterior segments, the glands have male characteristics, in the central segments hermaphroditic characteristics, and in the posterior segments the glands appear to be pure ovaries. In *Sabella* the ova and spermatozoa are found together throughout the organ in every segment of the body posterior to the pharynx. In *Sabella*, no cells were found corresponding to the nurse cells of *Ophryotrocha*. They evidently do not appear as ova were observed in many stages of development. In *Ophryotrocha* pure males and females were found besides hermaphrodites having male characteristics yet containing ova, and those having female characteristics yet containing spermatozoa. *Sabella* shows only two conditions, that of a pure female and that of an hermaphrodite having both female and male characteristics. The specimens appearing to be pure females could not have been hermaphrodites with the spermatozoa already developed for in the case of the April 1st forms, the organ as well as the whole animal was too small to have already produced spermatozoa. Where the ovaries were large no spermatozoa or trace of them was found in the body cavity as would have been expected if they had already developed.

Somewhat similar conditions of hermaphroditism have been observed in *Hesione sicula*¹ by W. Bergemann. Here a long gland is found differing in shape from the sex organ of *Sabella* but producing both ova and spermatozoa. This gland is seen only between the sixth and sixteenth segments. It is not found throughout the body as in the case of *Sabella*. Nurse cells are also seen in connection with the ova which is unlike the condition of *Sabella*. Like *Hesione*, the male cells in the hermaphroditic organ of *Sabella* are generally nearer to the blood vessel as is seen in Fig. 4, and usually the more mature the sex products are, the nearer are they to the outside of the organ. Whether or not the organ is developed from the walls of the blood vessel as in the case of *Hesione*, could not be determined from the material at my disposal.

VASSAR COLLEGE,
May 30, 1905.

¹ W. Bergemann, "Untersuchungen über die Eibildung bei Anneliden," *Zeit. f. Wiss. Zool.*, 1902, Bd. 73. "Ueber das spätere Schicksal der Zwitterdrüsen von *Hesione sicula*," *Zool. Anz.*, 1902-3, Bd. 26.